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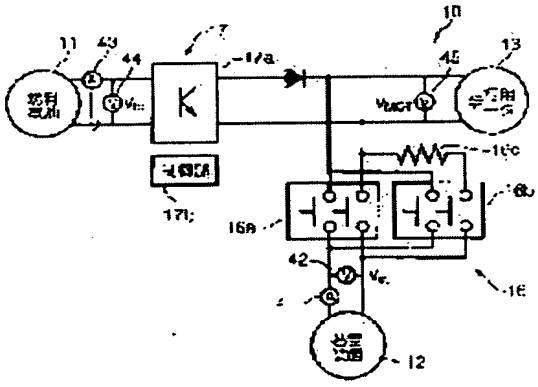
(54) START CONTROL DEVICE FOR FUEL CELL VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent the voltage between terminals from lowering when a fuel cell starts.

SOLUTION: A primary precharge part 16 is installed on the output side of an electric charge storage device 12 while a secondary precharge part 17 is installed on the output side of the fuel cell 11. The primary precharge part 16 is configured with a high voltage switch 16a and a current limiter 16b, wherein the switch 16a is opened when the current supplied to the electric load such as a motor for running 13 increases while the current limiter 16b equipped with a resistor 16c of the specified size is closed so that the current flows via the resistor 16c. The secondary precharge part 17 is configured with a DC-DC chopper 17a and a control part 17b, and the output current Ifc from the fuel cell 11 is controlled in conformity to the current command value IFCCMD emitted from ECU, i.e., the power generate command to the fuel cell 11.



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CLAIMS

[Claim(s)]
[Claim 1] The fuel cell which supplies power to a load, and the accumulation-of-electricity equipment which stores electricity the generation-of-electrical-energy energy of said fuel cell while assisting the electric power supply to said load, In the starting control unit of the fuel cell car equipped with the fuel cell driving means as which reactant gas is supplied to said fuel cell, and said fuel cell is operated, and a current-limiting means to restrict the output current of said fuel cell At the time of starting of said fuel cell, said accumulation-of-electricity equipment supplies power to said fuel cell driving means. Said current-limiting means forbids a current output until the output voltage of said fuel cell reaches a predetermined electrical potential difference. Said current-limiting means after said output voltage's rising more than a predetermined electrical potential difference The starting control unit of the fuel cell car characterized by restricting said output current to below a predetermined current value until the electrical-potential-difference difference of said output voltage of said fuel cell and the electrical potential difference between terminals of said accumulation-of-electricity equipment reaches a predetermined electrical-potential-difference difference.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the technique which starts a fuel cell in the power unit of the hybrid mold equipped with the accumulation-of-electricity equipment with which the starting control device of a fuel cell car is started, especially the electric power supply from a fuel cell is assisted.
[0002]
[Description of the Prior Art] The fuel cell power plant of the hybrid mold which used together the accumulation-of-electricity equipment which consists of a dc-battery, a capacitor (an electric double layer capacitor, capacitor), etc. in order to compensate the output responsibility of the fuel cell accompanied by supply of gas in the car with which the fuel cell of a solid-state macromolecule membrane type which consists of two or more cels was carried to the cel which put the solid-state polyelectrolyte film which consists of conventional, for example, solid-state, polymer ion exchange membrane etc. with the anode and the cathode, and was formed is known.
[0003]
[Problem(s) to be Solved by the Invention] By the way, in the fuel cell power plant concerning an example of the above-mentioned conventional technique, at the time of starting of a fuel cell, first, air is supplied to the pressure control valve for example, by the side of a fuel, fuel gas is supplied to the fuel electrode of a fuel cell with the supply pressure according to the pressure of this air, and a generation of electrical energy is started. Therefore, drive power is supplied from accumulation-of-electricity equipment to the air compressor which supplies air before starting of a fuel cell. Moreover, in addition to the drive of the auxiliary machinery for these fuel cell drive, and various control units, also when transit of a car is started immediately after starting of a fuel cell, an electric power supply is performed from accumulation-of-electricity equipment to a drive motor, the energy which accumulation-of-electricity equipment stores electricity falls, and the electrical potential difference between terminals of accumulation-of-electricity equipment falls. In this case, if the accumulation-of-electricity equipment in the condition that the electrical potential difference between terminals fell, and the fuel cell immediately after starting are connected directly, a rapidly big current will flow toward accumulation-of-electricity equipment from a fuel cell, and the electrical potential difference between terminals of a fuel cell will fall rapidly in the process in which both electrical potential difference between terminals shifts to equilibrium. Then, hydrogen and the moisture in the solid-state polyelectrolyte film of a fuel cell evaporate, for example, or there is a possibility that the endurance ability of a fuel cell may fall.
[0004] This invention was made in view of the above-mentioned situation, and aims at offering the starting control unit of the fuel cell car which can prevent that the electrical potential difference between terminals of a fuel cell falls too much at the time of starting of the fuel cell accompanying starting of a car etc.
[0005]
[Means for Solving the Problem] In order to attain the purpose which solves the above-mentioned technical problem and starts, the starting control unit of the fuel cell car of this invention according to claim 1 The fuel cell which supplies power to a load (for example, the drive motor 13 in this operation gestalt mentioned later, PDU14, air-compressor 15 grade) (for example, fuel cell 11 in this operation gestalt mentioned later), The accumulation-of-electricity equipment which stores electricity the generation-of-electrical-energy energy of said fuel cell while assisting the electric power supply to said load (for example, accumulation-of-electricity equipment 12 in this operation gestalt mentioned later), The fuel cell driving means as which reactant gas (for example, hydrogen gas and air in this operation gestalt mentioned later) is supplied to said fuel cell, and said fuel cell is operated (for example, air compressor 15 in this operation gestalt mentioned later), In the starting control unit of the fuel cell car equipped with a current-limiting means (for example, secondary precharge section 17 in this operation gestalt mentioned later) to restrict the output current (for example, output current Ifc in this operation gestalt mentioned later) of said fuel cell At the time of starting of said fuel cell, said accumulation-of-electricity equipment supplies power to said fuel cell driving means. The output voltage (for example, output voltage Vfc in this operation gestalt mentioned later) of said fuel cell said current-limiting means A predetermined electrical potential difference A current output is forbidden until it reaches (for example, VMOT**Vst**Vfc in this operation gestalt mentioned later). Said current-limiting means after said output voltage's rising more than a predetermined electrical potential difference Said output voltage of said fuel cell, and the electrical potential difference between terminals of said accumulation-of-electricity equipment It is characterized by restricting said output current to below a predetermined current value until an electrical-potential-difference difference with (for example, the electrical potential difference Vst between terminals in this operation gestalt mentioned later) reaches a predetermined electrical-potential-difference difference (for example, predetermined electrical-potential-difference difference deltaV in this operation gestalt mentioned later).
[0006] According to the starting control unit of the fuel cell car of the above-mentioned configuration, it can prevent that the electrical potential difference between terminals of a fuel cell falls rapidly by having had a current-limiting means to restrict the output current at the time of starting of a fuel cell. That is, in addition to the air pole of a fuel cell, at the time of starting of a fuel cell, air is first supplied by fuel cell driving means, such as an air compressor, as signal pressure to the amount control valve of pressure flow which supplies hydrogen gas to a fuel electrode as a fuel. In this case, power is supplied to a fuel cell driving means from accumulation-of-electricity equipment, and while the remaining capacity of accumulation-of-electricity equipment falls, the electrical potential difference between terminals of accumulation-of-electricity equipment falls. In addition, by having the precharge circuit which equipped accumulation-of-electricity equipment with the big resistor relatively, for example, it can prevent that can output the output current from accumulation-of-electricity equipment to a fuel cell driving means, PDU of a drive motor, etc. through a resistor, for example, a rapidly big current is outputted, and the so-called generating of the rush current can be prevented.

[0007] It can prevent that a rapidly big current flows from a fuel cell to the accumulation-of-electricity equipment with which the electrical potential difference between terminals fell with restricting the output current from a fuel cell after it forbids the current output from a fuel cell and the output voltage of a fuel cell rises more than a predetermined electrical potential difference until the output voltage of a fuel cell reaches a predetermined electrical potential difference with current-limiting means, such as DC[in this case]-DC chopper. And it is prevented that a rapidly big current flows toward accumulation-of-electricity equipment from a fuel cell, and while accumulation-of-electricity equipment is gradually charged according to the restricted output current, the electrical potential difference between terminals of accumulation-of-electricity equipment and the electrical potential difference between terminals of a fuel cell shift to balanced voltages mutually, until the electrical-potential-difference difference of the electrical potential difference between terminals of a fuel cell and the electrical potential difference between terminals of accumulation-of-electricity equipment turns into below the predetermined electrical-potential-difference difference containing zero. For this reason, in the process which shifts to balanced voltages, hydrogen and the moisture in the solid-state polyelectrolyte film of a fuel cell can evaporate, or it can prevent that the endurance ability of a fuel cell falls, and can ** to prolongation-of-life-ization of the life of a fuel cell because the electrical potential difference between terminals of a fuel cell falls too much exceeding a predetermined electrical potential difference.
[0008] And the output current is easily controllable by changing the duty of pulse current inputted into control of chopping actuation using for example, DC-DC chopper etc. as a current-limiting means, and time amount until each electrical potential differences between terminals of a fuel cell and accumulation-of-electricity equipment reach balanced voltages can be shortened, preventing that the electrical potential difference between terminals of a fuel cell falls too much. furthermore, even if it is the case that the electrical-potential-difference difference of the electrical potential difference between terminals of a fuel cell and accumulation-of-electricity equipment is big, it can prevent that an arc occurs [which is boiled when changing an output path with the switch of for example, a contact method etc. and making a current output through a resistor by using for example, DC-DC chopper as a current control means] like at the time of contact release, and the fault of a contact welding occurs.
[0009]
[Embodiment of the Invention] Hereafter, it explains, referring to an accompanying drawing about 1 operation gestalt of the starting control unit of the fuel cell car of this invention. Drawing 1 is the block diagram of the fuel cell car 1 equipped with the starting control unit 10 of the fuel cell car concerning 1 operation gestalt of this invention, drawing 2 is the important section block diagram of the starting control unit 10 of the fuel cell car shown in drawing 1 , and drawing 3 is a block diagram of DC-DC chopper 17a shown in drawing 1 . It has the power unit of the hybrid mold which consisted of a fuel cell 11 and accumulation-of-electricity equipment 12, and the fuel cell car 1 concerning the gestalt of this operation is transmitted to a driving wheel W through transmission T/M which the driving force of the drive motor 13 with which power is supplied from these power units becomes from an automatic transmission or manual transmission. Moreover, if driving force is transmitted to a drive motor 13 side from a driving wheel W side at the time of moderation of the fuel cell car 1, a drive motor 13 will function as a generator, will generate the so-called regenerative-braking force, and will collect the kinetic energy of a car body as electrical energy.
[0010] The starting control unit 10 of the fuel cell car by the gestalt of this operation is equipped with a fuel cell 11, accumulation-of-electricity equipment 12, a drive motor 13, PDU14, the air compressor 15 as auxiliary machinery for a fuel cell drive, the primary precharge section 16, the secondary precharge section 17, and ECU18, and is constituted.
[0011] The drive motor 13 is made into the three-phase-circuit alternating current synchronous motor of the permanent magnet type which uses a permanent magnet as a field, and drive control is carried out with the three-phase-circuit alternating current power supplied from PDU14. PDU14 is equipped with the PWM inverter which consisted of switching elements, such as IGBT, changes into three-phase-circuit alternating current power the direct current power outputted from a fuel cell 11 and accumulation-of-electricity equipment 12 based on the torque command outputted from ECU18, and supplies it to a drive motor 13.
[0012] The fuel cell 11 consisted of a stack constituted by carrying out the laminating of two or more cels to the cel which put the solid-state polyelectrolyte film which consists for example, of solid-state polymer ion exchange membrane etc. from both sides with the anode and the cathode, and was formed, and is equipped with the hydrogen pole to which hydrogen gas is supplied as a fuel, and the air pole to which the air which contains oxygen as an oxidizer is supplied. And the hydrogen ion generated by catalytic reaction in the anode passes the solid-state polyelectrolyte film, and moves even a cathode, and with a cathode, oxygen and electrochemical reaction are caused and it generates electricity.
[0013] And the fuel feed zone 21 connected to the fuel electrode side of a fuel cell 11 is equipped with the pressure control section 22 which supplies hydrogen gas by the pressure according to the air supplied as signal pressure from the control signal outputted from ECU18, or an air compressor 15. The air compressor 15 connected to the air pole side of a fuel cell 11 supplies air as signal pressure to the pressure control section 22 which consists of an amount control valve of pressure flow in addition to the air pole of a fuel cell 11. For this reason, the rotational frequency command value N over the motor which drives an air compressor 15 is inputted into the control section 23 of an air compressor 15 from ECU18.
[0014] Let accumulation-of-electricity equipment 12 be the capacitor which consists of an electric double layer capacitor, an electrolytic capacitor, etc. And a fuel cell 11 and accumulation-of-electricity equipment 12 are connected to juxtaposition to the drive motor 13 which is electrical load.
[0015] Furthermore, the primary precharge section 16 is arranged at the output side of accumulation-of-electricity equipment 12, and the secondary precharge section 17 is arranged at the output side of a fuel cell 11. The primary precharge section 16 is equipped with high-pressure switch 16a and current limiter 16b, and if the current supplied to the electrical load of drive motor 13 grade becomes large, while releasing high-pressure switch 16a, current limiter 16b equipped with resistor 16c of predetermined magnitude is closed, and it is made for a current to flow through resistor 16c, as shown in drawing 2 R> 2. For this reason, high-pressure switch 16a is equipped with the relay connected to each output terminal of the positive electrode of accumulation-of-electricity equipment 12, and a negative electrode, and is controlled based on the control signal of the switching action outputted from ECU18. Current limiter 16b is equipped with the relay which was connected to high-pressure switch 16a and juxtaposition, for example, was connected to each output terminal of the positive electrode of accumulation-of-electricity equipment 12, and a negative electrode, and resistor 16c of predetermined magnitude, and the current outputted from accumulation-of-electricity equipment 12 is supplied to PDU14 through resistor 16c.
[0016] It has DC-DC chopper 17a and control-section 17b, and is constituted, and the secondary precharge section 17 controls the output current Ifc from a fuel cell 11 based on the generation-of-electrical-energy command to the current command value IFCCMD 11, i.e., a fuel cell, outputted from ECU18. It is DC as shown in drawing 3 . - Pulse current is supplied to the base of Transistor TR, for example from control-section 17b, and ON/OFF of Transistor TR are controlled by DC chopper17a. If the current outputted becomes large, control-section 17b will change the duty of pulse current so that the OFF state of Transistor TR may become long, and it restricts the current outputted. In addition, diode is arranged between the primary precharge section 16 and the secondary precharge section 17, and the back flow of the current from accumulation-of-electricity equipment 12 to a fuel cell 11 is prevented.

[0017] In addition, as shown in drawing 1 , in addition to PDU14, the control section 23 of an air compressor 15 is connected to a fuel cell 11 and juxtaposition through the secondary precharge section 17. Furthermore, the 12-volt auxiliary dc-battery 24 which drives the various control devices and auxiliary machinery of the fuel cell car 1 is equipped with DC-DC converter 25, and DC-DC converter 25 lowers the pressure of the direct current voltage supplied from a fuel cell 11 through the secondary precharge section 17, and charges the auxiliary dc-battery 24. Moreover, it connects with a fuel cell 11 and juxtaposition through the secondary precharge section 17, and the control device 27 of the motor 26 which drives an air conditioner changes into alternating current power the direct current power outputted from a fuel cell 11 and accumulation-of-electricity equipment 12, and supplies it to a motor 26.
[0018] ECU18 is equipped with a motor ECU 31, the fuel cell control section 32, and the accumulation-of-electricity device control section 33, and is constituted. The motor ECU 31 is controlling power conversion actuation of the PWM inverter provided in PDU14. U phase alternating-voltage command value *Vu, V phase alternating-voltage command value *Vv, and W phase alternating-voltage command value *Vw are outputted to PDU14 as a switching command. these -- each -- the U phase current Iu, the V phase current Iv, and the W phase current Iw according to electrical-potential-difference command value *Vu, *Vv, and *Vw are made to output to each phase of a drive motor 11 from PDU14 On a motor ECU 31, for this reason, for example, the signal of accelerator control input thetaTh about treading-in actuation of the accelerator pedal by the operator etc., The signal of the magnetic pole location (electrical angle) outputted from the magnetic pole location-angular-velocity detector 35 with which the drive motor 13 was equipped, The signal of each phase currents Iu, Iv, and Iw supplied to a drive motor 11 from PDU14, the signal of the motor current Imotor made into a dc component, and the signal of supply voltage Vdc-in supplied to PDU14 are inputted.
[0019] While the fuel cell control section 32 outputs the rotational frequency command value N as a drive command to the auxiliary machinery for a fuel cell drive of for example, air-compressor 15 grade Are controlling actuation of primary and the secondary precharge sections 16 and 17, and actuation of each relay contact provided in high-pressure switch 16a and current limiter 16b of the primary precharge section 16 is controlled. Furthermore, the current command value IFCCMD is outputted as a switching command to DC-DC chopper 17a of the secondary precharge section 17. To the fuel cell control section 32, for this reason, for example, output request value *P to the drive motor 13 outputted from a motor ECU 31 and the signal about the output value P from a drive motor 13, The signal of motor current Is/c of a motor which drives the air compressor 15 outputted from a control section 23, The output current Ifc of the fuel cell 11 outputted from the secondary precharge section 17, the signal of output voltage Vfc, and DC of the secondary precharge section 17 - The signal of direct-current-voltage Vdc-out outputted from DC chopper17a, The signal of current value Iout-Total outputted from the current detector 36 arranged between the primary precharge section 16 and the secondary precharge section 17 is inputted.
[0020] The accumulation-of-electricity device control section 33 computes the remaining capacity SOC of accumulation-of-electricity equipment 12, and outputs it to a motor ECU 31 and the fuel cell control section 32. For this reason, the signal of the output current Ist of the accumulation-of-electricity equipment 12 outputted from accumulation-of-electricity equipment 12, the electrical potential difference Vst between terminals, and temperature Tst is inputted into the accumulation-of-electricity device control section 33.
[0021] namely, as shown in drawing 2 , to ECU18 which controls processing of current limiting in primary and the secondary precharge sections 16 and 17 The signal from the 1st current detector 41 which detects the output current Ist of accumulation-of-electricity equipment 12, The signal from the 1st electrical-potential-difference detector 42 which detects the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12, The signal from the 2nd current detector 43 which detects the output current Ifc of a fuel cell 11, the signal from the 2nd electrical-potential-difference detector 44 which detects the output voltage Vfc of a fuel cell 11, and the signal from the 3rd electrical-potential-difference detector 45 which detects the motor electrical potential difference VMOT of a drive motor 13 are inputted.
[0022] The starting control unit 10 of the fuel cell car by the gestalt of this operation is explained having the above-mentioned configuration, next referring to an accompanying drawing especially about actuation of the starting control unit 10 of this fuel cell car, primary [at the time of starting of the fuel cell car 1], and processing of the current control in the secondary precharge sections 16 and 17. Drawing 4 is a flow chart which shows actuation of the starting control device 10 of a fuel cell car, and drawing 5 is the graphical representation showing change with the output voltage Vfc of a fuel cell 11 and the output current Ifc, the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12, and the connection flag of high-pressure switch 16a.
[0023] For example, in the time of starting of a car etc., a fuel cell 11, accumulation-of-electricity equipment 12, and PDU14 are mutually made into the cutting condition, and have a value different mutually [output voltage Vfc the electrical potential difference Vst between terminals, and the motor electrical potential difference VMOT], for example. First, in step S01 shown in drawing 4 , current limiting is processed by the primary precharge section 16. That is, while releasing each relay contact of high-pressure switch 16a, each relay contact of current limiter 16b is operated, and the current outputted from accumulation-of-electricity equipment 12 is made to be outputted through resistor 16c.
[0024] Next, in step S02, it is in the condition to which the motor electrical potential difference VMOT and the electrical potential difference Vfc between terminals reached equilibrium mostly, i.e., the condition used as VMOT**Vst, and each relay contact of high-pressure switch 16a is operated. And in step S03, each relay contact of a current limiter 22 is released. Thereby, the current outputted from accumulation-of-electricity equipment 13 is outputted through high-pressure switch 16a, for example, serves as VMOT**Vst! =Vfc.
[0025] Next, a fuel cell 11 is started in step S04. namely, the air pole of a fuel cell 11 -- in addition -- for example, the air compressor 15 which supplies air as signal pressure to the pressure control section 22 for the fuel supply to a fuel cell 11 is driven. The power for driving an air compressor 15 from accumulation-of-electricity equipment 12 is supplied by this, and the energy of accumulation-of-electricity equipment 12 falls. Next, in step S05, while the 1st electrical-potential-difference detector 42 detects the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12, the 2nd electrical-potential-difference detector 44 detects the output voltage Vfc of a fuel cell 11.
[0026] Next, in step S06, the value which subtracted the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12 from the output voltage Vfc of a fuel cell 11 judges whether it is more than predetermined electrical-potential-difference difference deltaV. When this judgment result is "YES", it progresses to step S07 and sets in the secondary precharge section 17, and it is DC. - The current outputted from DC chopper17a is restricted to a predetermined current value, and processing not more than step S05 is performed.
[0027] When the judgment result in step S06 is "NO", on the other hand, it progresses to step S08, and is DC in the transient limit mode 17, i.e., the secondary precharge section. - It is set as the hydrogen gas to which the current outputted from DC chopper17a is supplied by the fuel cell 11, and the value according to the amount of air, and a series of processings are ended.
[0028] That is, when controlling the output current Ifc of a fuel cell 11 by DC-DC chopper 17a of the secondary precharge section 17 to be shown, for example in drawing 5 , the time amount taken for the output voltage Vfc of a fuel cell 11 and the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12 to reach balanced voltages (VMOT**Vst**Vfc) can be

adjusted by changing the duty of a switching command inputted into DC-DC chopper 17a.
[0029] As mentioned above, according to the starting control unit 10 of the fuel cell car by the gestalt of this operation Since the current from accumulation-of-electricity equipment 12 is first outputted through resistor 16c by the primary precharge section 16 arranged at the output side of accumulation-of-electricity equipment 12 at the time of starting of a fuel cell 11, For example, it can prevent that the so-called rush current to which a rapidly big current flows to the capacitor (for example, electrolytic capacitor shown in drawing 1) provided in PDU14, the control section 23 of an air compressor 15, or the input side of DC-DC converter 25 occurs. And after [a loads side, such as for example, the motor electrical potential difference VMOT,] an electrical potential difference becomes almost equal to the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12 With restricting the output current Ifc of a fuel cell 11 by the secondary precharge section 17 For example, it prevents that a rapidly big current flows toward the accumulation-of-electricity equipment 12 with which the electrical potential difference Vst between terminals fell by the electric power supply of the auxiliary machinery for a fuel cell drive of air-compressor 15 grade. In the process which shifts to balanced voltages with the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12, it can prevent that the output voltage Vfc of a fuel cell 11 declines too much.
[0030] And the output current Ifc is easily controllable by changing the duty of pulse current inputted into control of chopping actuation using DC-DC chopper 17a in the secondary precharge section 17, and time amount until the output voltage Vfc of a fuel cell 11 and the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12 reach balanced voltages can be shortened, preventing that the output voltage Vfc of a fuel cell 11 declines too much. Moreover, even if it is the case that the electrical-potential-difference difference of the output voltage Vfc of a fuel cell 11 and the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12 is big, it can prevent that an arc occurs at the time of contact release, and the fault of a contact welding occurs, for example like the primary precharge section 16 [the case where change an output path with the switch of a contact method etc., and a current is outputted through resistor 16c].
[0031] In addition, in the gestalt of this operation, although considered as the current-limiting circuit of the chopper method which consists for example, of a DC-DC chopper as the primary precharge section 16, it may not be limited to this, for example, you may be a current-limiting circuit by the method of others, such as a current-limiting circuit of a transistor mold, and a DEPURESHON mold FET type current-limiting circuit.
[0032]
[Effect of the Invention] As explained above, according to the starting control unit of the fuel cell car of this invention according to claim 1, it can prevent that the electrical potential difference between terminals of a fuel cell falls rapidly by having had a current-limiting means to restrict the output current at the time of starting of a fuel cell. That is, it can prevent that a rapidly big current flows from a fuel cell to the accumulation-of-electricity equipment with which energy was consumed for the drive of a fuel cell, and the electrical potential difference between terminals fell. And since the electrical potential difference between terminals of accumulation-of-electricity equipment and the electrical potential difference between terminals of a fuel cell shift to balanced voltages mutually while accumulation-of-electricity equipment is gradually charged according to the restricted output current, For example, hydrogen and the moisture in the solid-state polyelectrolyte film of a fuel cell can evaporate, or it can prevent that the endurance ability of a fuel cell falls, and can ** to prolongation-of-life-ization of the life of a fuel cell because the electrical potential difference between terminals of a fuel cell falls too much exceeding a predetermined electrical potential difference.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of a fuel cell car equipped with the starting control unit of the fuel cell car concerning 1 operation gestalt of this invention.
[Drawing 2] It is the important section block diagram of the starting control unit of the fuel cell car shown in drawing 1 .
[Drawing 3] It is the block diagram of DC-DC chopper shown in drawing 1 .
[Drawing 4] It is the flow chart which shows actuation of the starting control device of the fuel cell car shown in drawing 1 .
[Drawing 5] It is the graphical representation showing change with the output voltage Vfc of a fuel cell and the output current Ifc which are shown in drawing 1 , the electrical potential difference Vst between terminals of accumulation-of-electricity equipment, and the connection flag of a high-pressure switch.
[Description of Notations]
1 Fuel Cell Car
10 Starting Control Unit of Fuel Cell Car
11 Fuel Cell
12 Accumulation-of-Electricity Equipment
15 Air Compressor (Fuel Cell Driving Means)
17 Secondary Precharge Section (Current-Limiting Means)

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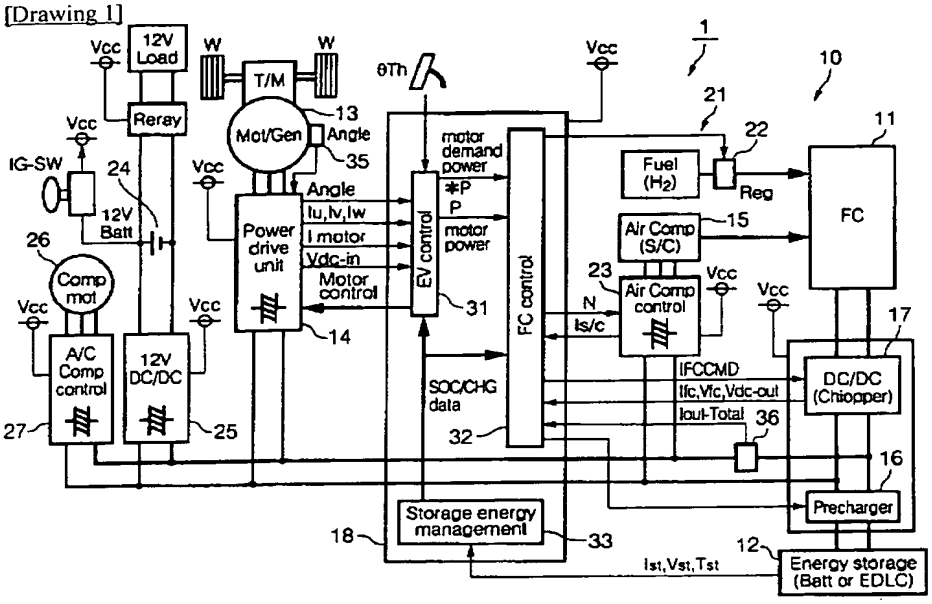
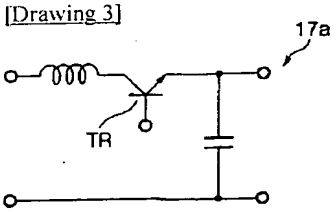
DRAWINGS

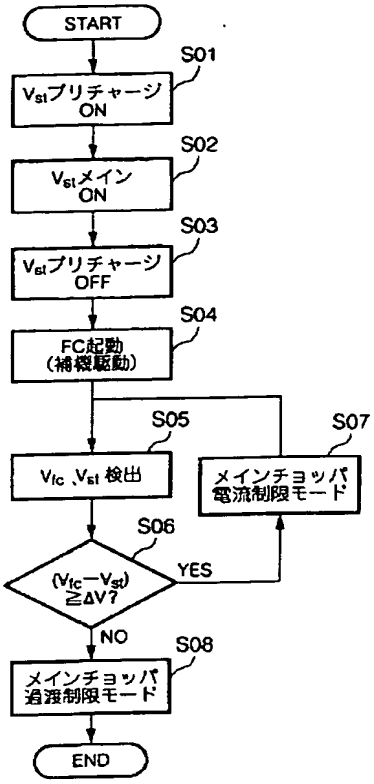
[Drawing 1]



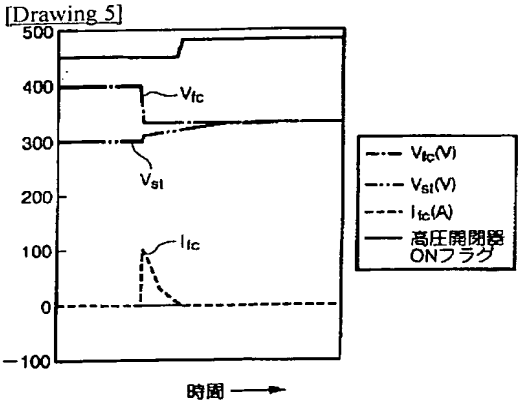
[Drawing 3]



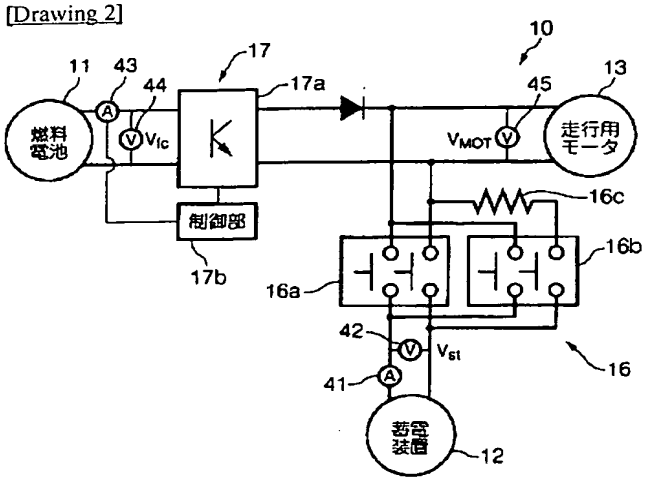
[Drawing 4]



[Drawing 5]



[Drawing 2]



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CORRECTION OR AMENDMENT

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[Procedure amendment 1]
[Document to be Amended] Specification
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[Method of Amendment] Modification
[The contents of amendment]
[Title of the Invention] The starting control unit and fuel cell power-source system of a fuel cell car
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[The contents of amendment]
[Claim(s)]
[Claim 1]
In the starting control unit of the fuel cell car equipped with the fuel cell which supplies power to a load, the capacitor with which the electric power supply to said load is assisted, the fuel cell driving means as which reactant gas is supplied to said fuel cell, and said fuel cell is operated, and a current-limiting means to restrict the output current of said fuel cell,
At the time of starting of said fuel cell, said capacitor supplies power to said fuel cell driving means, and said current-limiting means forbids a current output until the output voltage of said fuel cell reaches a predetermined electrical potential difference,
Said current-limiting means after said output voltage's rising more than a predetermined electrical potential difference is the starting control unit of the fuel cell car characterized by restricting said output current to below a predetermined current value until the electrical-potential-difference difference of said output voltage of said fuel cell and the electrical potential difference between terminals of said capacitor reaches a predetermined electrical-potential-difference difference.
[Claim 2]
The fuel cell which supplies power to a load,
The capacitor with which the electric power supply to said load is assisted,
It is a fuel cell power-source system equipped with a switching means to be established between said fuel cells and said capacitors, and to intercept or connect the output side and said capacitor of said fuel cell,
It has the control section which controls said switching means,
Said control section is a fuel cell power-source system characterized by carrying out chopping control of said switching means when connecting said fuel cell and said capacitor and the difference of the both-ends electrical potential difference of said capacitor and the both-ends electrical potential difference of said fuel cell is beyond a predetermined value.
[Claim 3]
The fuel cell which supplies power to a load,
The capacitor with which the electric power supply to said load is assisted,
It is a fuel cell power-source system equipped with the connecting means which is established between said fuel cells and said capacitors, and connects the output side and said capacitor of said fuel cell,
It has the control section which controls the connection condition of said connecting means,
Said control section is a fuel cell power-source system characterized by restricting the amount of energization of the current energized

from said fuel cell to said capacitor when connecting said fuel cell and said capacitor and the difference of the both-ends electrical potential difference of said capacitor and the both-ends electrical potential difference of said fuel cell is beyond a predetermined value.

[Claim 4]
Said control section is a fuel cell power-source system according to claim 2 or 3 characterized by connecting said fuel cell and said capacitor after said fuel cell starts.
[Procedure amendment 3]
[Document to be Amended] Specification
[Item(s) to be Amended] 0003
[Method of Amendment] Modification
[The contents of amendment]
[0003]
[Problem(s) to be Solved by the Invention]
By the way, in the fuel cell power plant concerning an example of the above-mentioned conventional technique, at the time of starting of a fuel cell, first, air is supplied to the pressure control valve for example, by the side of a fuel, fuel gas is supplied to the fuel electrode of a fuel cell with the supply pressure according to the pressure of this air, and a generation of electrical energy is started. Therefore, drive power is supplied from accumulation-of-electricity equipment to the air compressor which supplies air before starting of a fuel cell. Moreover, in addition to the drive of the auxiliary machinery for these fuel cell drive, and various control units, also when transit of a car is started immediately after starting of a fuel cell, an electric power supply is performed from accumulation-of-electricity equipment to a drive motor, the energy which accumulation-of-electricity equipment stores electricity falls, and the electrical potential difference between terminals of accumulation-of-electricity equipment falls.
In this case, if the accumulation-of-electricity equipment in the condition that the electrical potential difference between terminals fell, and the fuel cell immediately after starting are connected directly, a rapidly big current will flow toward accumulation-of-electricity equipment from a fuel cell, and the electrical potential difference between terminals of a fuel cell will fall rapidly in the process in which both electrical potential difference between terminals shifts to equilibrium. Then, hydrogen and the moisture in the solid-state polyelectrolyte film of a fuel cell evaporate, for example, or there is a possibility that the endurance ability of a fuel cell may fall.
When a fuel cell is connected to accumulation-of-electricity equipment in this way in the situation that the both-ends electrical potential difference (that is, electrical potential difference between terminals) of accumulation-of-electricity equipments, such as the time of starting of a fuel cell, differs from the both-ends electrical potential difference (that is, output voltage) of a fuel cell, a rapidly big current flows, the engine performance of a fuel cell deteriorates or there is a possibility that endurance ability may fall.
[Procedure amendment 4]
[Document to be Amended] Specification
[Item(s) to be Amended] 0005
[Method of Amendment] Modification
[The contents of amendment]
[0005]
[Means for Solving the Problem] In order to attain the purpose which solves the
 above-mentioned technical problem and starts, the starting control unit of the fuel cell car of this invention according to claim 1 The fuel cell which supplies power to a load (for example, the drive motor 13 in this operation gestalt mentioned later, PDU14, air-compressor 15 grade) (for example, fuel cell 11 in this operation gestalt mentioned later), The capacitor with which the electric power supply to said load is assisted (for example, accumulation-of-electricity equipment 12 in this operation gestalt mentioned later), The fuel cell driving means as which reactant gas (for example, hydrogen gas and air in this operation gestalt mentioned later) is supplied to said fuel cell, and said fuel cell is operated (for example, air compressor 15 in this operation gestalt mentioned later), In the starting control unit of the fuel cell car equipped with a current-limiting means (for example, secondary precharge section 17 in this operation gestalt mentioned later) to restrict the output current (for example, output current Ifc in this operation gestalt mentioned later) of said fuel cell At the time of starting of said fuel cell, said capacitor supplies power to said fuel cell driving means. The output voltage (for example, output voltage Vfc in this operation gestalt mentioned later) of said fuel cell said current-limiting means A predetermined electrical potential difference A current output is forbidden until it reaches (for example, VMOT**Vst**Vfc in this operation gestalt mentioned later). Said current-limiting means after said output voltage's rising more than a predetermined electrical potential difference Said output voltage of said fuel cell, and the electrical potential difference between terminals of said capacitor It is characterized by restricting said output current to below a predetermined current value until an electrical-potential-difference difference with (for example, the electrical potential difference Vst between terminals in this operation gestalt mentioned later) reaches a predetermined electrical-potential-difference difference (for example, predetermined electrical-potential-difference difference deltaV in this operation gestalt mentioned later).
[Procedure amendment 5]
[Document to be Amended] Specification
[Item(s) to be Amended] 0006
[Method of Amendment] Modification
[The contents of amendment]
[0006]
According to the starting control unit of the fuel cell car of the above-mentioned configuration, it can prevent that the electrical potential difference between terminals of a fuel cell falls rapidly by having had a current-limiting means to restrict the output current at the time of starting of a fuel cell.
That is, in addition to the air pole of a fuel cell, at the time of starting of a fuel cell, air is first supplied by fuel cell driving means, such as an air compressor, as signal pressure to the amount control valve of pressure flow which supplies hydrogen gas to a fuel electrode as a fuel. In this case, power is supplied to a fuel cell driving means from a capacitor, and while the remaining capacity of a capacitor falls, the electrical potential difference between terminals of a capacitor falls. In addition, by having the precharge circuit which equipped the capacitor with the big resistor relatively, for example, it can prevent that can output the output current from a capacitor to a fuel cell driving means, PDU of a drive motor, etc. through a resistor, for example, a rapidly big current is outputted, and the so-called generating of the rush current can be prevented.
[Procedure amendment 6]
[Document to be Amended] Specification
[Item(s) to be Amended] 0007
[Method of Amendment] Modification

[The contents of amendment]
[0007]
It can prevent that a rapidly big current flows from a fuel cell to the capacitor with which the electrical potential difference between terminals fell with restricting the output current from a fuel cell after it forbids the current output from a fuel cell and the output voltage of a fuel cell rises more than a predetermined electrical potential difference until the output voltage of a fuel cell reaches a predetermined electrical potential difference with current-limiting means, such as DC[in this case]-DC chopper.
And it is prevented that a rapidly big current flows toward a capacitor from a fuel cell, and while a capacitor is gradually charged according to the restricted output current, the electrical potential difference between terminals of a capacitor and the electrical potential difference between terminals of a fuel cell shift to balanced voltages mutually, until the electrical-potential-difference difference of the electrical potential difference between terminals of a fuel cell and the electrical potential difference between terminals of a capacitor turns into below the predetermined electrical-potential-difference difference containing zero. For this reason, in the process which shifts to balanced voltages, hydrogen and the moisture in the solid-state polyelectrolyte film of a fuel cell can evaporate, or it can prevent that the endurance ability of a fuel cell falls, and can ** to prolongation-of-life-ization of the life of a fuel cell because the electrical potential difference between terminals of a fuel cell falls too much exceeding a predetermined electrical potential difference.
[Procedure amendment 7]
[Document to be Amended] Specification
[Item(s) to be Amended] 0008
[Method of Amendment] Modification
[The contents of amendment]
[0008]
And the output current is easily controllable by changing the duty of pulse current inputted into control of chopping actuation using for example, DC-DC chopper etc. as a current-limiting means, and time amount until each electrical potential differences between terminals of a fuel cell and a capacitor reach balanced voltages can be shortened, preventing that the electrical potential difference between terminals of a fuel cell falls too much.
Furthermore, even if it is the case that the electrical-potential-difference difference of the electrical potential difference between terminals of a fuel cell and a capacitor is big, compared with the case where change an output path with the switch of for example, a contact method etc., and a current is made to output through a resistor by using for example, DC-DC chopper as a current control means, it can prevent further that fault occurs.
Furthermore, the fuel cell power-source system of this invention according to claim 2 The fuel cell which supplies power to a load, and the capacitor with which the electric power supply to said load is assisted, It is a fuel cell power-source system equipped with a switching means (DC in the operation gestalt mentioned later - DC chopper17a) to be established between said fuel cells and said capacitors, and to intercept or connect the output side and said capacitor of said fuel cell. It has the control section (control-section 17b in the operation gestalt mentioned later) which controls said switching means. Said control section When connecting said fuel cell and said capacitor, the both-ends electrical potential difference of said capacitor When the difference of (for example, the electrical potential difference Vst between terminals in this operation gestalt mentioned later) and the both-ends electrical potential difference (for example, output voltage Vfc in this operation gestalt mentioned later) of said fuel cell is beyond a predetermined value, it is characterized by carrying out chopping control of said switching means.
Furthermore, the fuel cell power-source system of this invention according to claim 3 The fuel cell which supplies power to a load, and the capacitor with which the electric power supply to said load is assisted, the connecting means (DC-DC chopper 17a in the operation gestalt mentioned later --) which is established between said fuel cells and said capacitors, and connects the output side and said capacitor of said fuel cell the control section (control-section 17b in the operation gestalt mentioned later --) which is a fuel cell power-source system equipped with current limiter 16b, and controls the connection condition of said connecting means It has the fuel cell control section 32. Said control section When connecting said fuel cell and said capacitor, the both-ends electrical potential difference of said capacitor (For example, the electrical potential difference Vst between terminals in this operation gestalt mentioned later), and the both-ends electrical potential difference of said fuel cell When a difference with (for example, the output voltage Vfc in this operation gestalt mentioned later) is beyond a predetermined value, it is characterized by restricting the amount of energization of the current energized from said fuel cell to said capacitor (for example, output current Ifc in this operation gestalt mentioned later).
Furthermore, in the fuel cell power-source system of this invention according to claim 4, after said fuel cell starts said control section, it is characterized by connecting said fuel cell and said capacitor.
[Procedure amendment 8]
[Document to be Amended] Specification
[Item(s) to be Amended] 0016
[Method of Amendment] Modification
[The contents of amendment]
[0016]
It has DC-DC chopper 17a and control-section 17b, and is constituted, and the secondary precharge section 17 controls the output current Ifc from a fuel cell 11 based on the generation-of-electrical-energy command to the current command value IFCCMD 11, i.e., a fuel cell, outputted from ECU18.
It is DC as shown in drawing 3. - Pulse current is supplied to the base of Transistor TR, for example from control-section 17b, and ON/OFF of Transistor TR are controlled by DC chopper17a. If the current outputted becomes large, control-section 17b will change the duty (that is, ON / off ratio) of pulse current so that the OFF state of Transistor TR may become long, and it restricts the current outputted.
In addition, diode is arranged between the primary precharge section 16 and the secondary precharge section 17, and the back flow of the current from accumulation-of-electricity equipment 12 to a fuel cell 11 is prevented.
[Procedure amendment 9]
[Document to be Amended] Specification
[Item(s) to be Amended] 0019
[Method of Amendment] Modification
[The contents of amendment]
[0019]
While the fuel cell control section 32 outputs the rotational frequency command value N as a drive command to the auxiliary machinery for a fuel cell drive of for example, air-compressor 15 grade Are controlling actuation of primary and the secondary precharge sections 16 and 17, and actuation of each relay contact provided in high-pressure switch 16a and current limiter 16b of the

primary precharge section 16 is controlled. Furthermore, the current command value IFCCMD is outputted as a switching command to DC-DC chopper 17a of the secondary precharge section 17, and chopping control of the DC-DC chopper 17a is carried out.
To the fuel cell control section 32, for this reason, for example, output request value *P to the drive motor 13 outputted from a motor ECU 31 and the signal about the output value P from a drive motor 13, The signal of motor current Is/c of a motor which drives the air compressor 15 outputted from a control section 23, The output current Ifc of the fuel cell 11 outputted from the secondary precharge section 17, the signal of output voltage Vfc, and DC of the secondary precharge section 17 - The signal of direct-current-voltage Vdc-out outputted from DC chopper17a, The signal of current value Iout-Total outputted from the current detector 36 arranged between the primary precharge section 16 and the secondary precharge section 17 is inputted.
[Procedure amendment 10]
[Document to be Amended] Specification
[Item(s) to be Amended] 0024
[Method of Amendment] Modification
[The contents of amendment]
[0024]
Next, in step S02, it is in the condition to which the motor electrical potential difference VMOT and the electrical potential difference Vst between terminals reached equilibrium mostly, i.e., the condition used as VMOT**Vst, and each relay contact of high-pressure switch 16a is operated.
And in step S03, each relay contact of current limiter 16b is released. Thereby, the current outputted from accumulation-of-electricity equipment 12 is outputted through high-pressure switch 16a, for example, serves as VMOT**Vst!=Vfc.
[Procedure amendment 11]
[Document to be Amended] Specification
[Item(s) to be Amended] 0028
[Method of Amendment] Modification
[The contents of amendment]
[0028]
namely, in controlling the output current Ifc of a fuel cell 11 by DC-DC chopper 17a of the secondary precharge section 17 to be shown, for example in drawing 5 By changing the duty (that is, ON / off ratio) of a switching command inputted into DC-DC chopper 17a Chopping control of the DC-DC chopper 17a can be carried out, and the time amount taken for the output voltage Vfc of a fuel cell 11 and the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12 to reach balanced voltages (VMOT**Vst**Vfc) can be adjusted.
[Procedure amendment 12]
[Document to be Amended] Specification
[Item(s) to be Amended] 0030
[Method of Amendment] Modification
[The contents of amendment]
[0030]
By and the thing for which DC-DC chopper 17a is used in the secondary precharge section 17 The output current Ifc is easily controllable by changing the duty (that is, ratio of ON/OFF) of pulse current inputted into control (chopping control) of chopping actuation. Time amount until the output voltage Vfc of a fuel cell 11 and the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12 reach balanced voltages can be shortened preventing that the output voltage Vfc of a fuel cell 11 declines too much.
Moreover, even if it is the case that the electrical-potential-difference difference of the output voltage Vfc of a fuel cell 11 and the electrical potential difference Vst between terminals of accumulation-of-electricity equipment 12 is big, compared with the case where change an output path with the switch of a contact method like the primary precharge section 16 etc., and a current is outputted through resistor 16c by performing current limiting by DC-DC chopper 17a as the secondary precharge section 17, it can prevent further that fault occurs.
[Procedure amendment 13]
[Document to be Amended] Specification
[Item(s) to be Amended] 0032
[Method of Amendment] Modification
[The contents of amendment]
[0032]
[Effect of the Invention]
As explained above, according to the starting control unit of the fuel cell car of this invention according to claim 1, it can prevent that the electrical potential difference between terminals of a fuel cell falls rapidly by having had a current-limiting means to restrict the output current at the time of starting of a fuel cell.
That is, it can prevent that a rapidly big current flows from a fuel cell to the capacitor with which energy was consumed for the drive of a fuel cell, and the electrical potential difference between terminals fell. And since the electrical potential difference between terminals of a capacitor and the electrical potential difference between terminals of a fuel cell shift to balanced voltages mutually while a capacitor is gradually charged according to the restricted output current, For example, hydrogen and the moisture in the solid-state polyelectrolyte film of a fuel cell can evaporate, or it can prevent that the endurance ability of a fuel cell falls, and can ** to prolongation-of-life-ization of the life of a fuel cell because the electrical potential difference between terminals of a fuel cell falls too much exceeding a predetermined electrical potential difference.
Moreover, according to the fuel cell power-source system of this invention according to claim 2, it can prevent that a rapidly big current flows from a fuel cell to a capacitor by carrying out chopping control of the DC-DC chopper as a switching means etc.
Moreover, according to the fuel cell power-source system of this invention according to claim 3, it can prevent that a rapidly big current flows from a fuel cell to a capacitor by controlling the connection conditions of providing DC-DC chopper and the resistor as a connecting means, such as a switch of a contact method.
Furthermore, according to the fuel cell power-source system of this invention according to claim 4, the both-ends electrical potential difference of a fuel cell can prevent falling too much exceeding a predetermined electrical potential difference, and can ** it to prolongation-of-life-ization of the life of a fuel cell.

[Translation done.]